Army's MANPRINT Puts Humans on Par With Technology

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WEST PALM BEACH, Fla. Have you ever changed the oil in your car and wondered why the engineers made it so darned hard to do?

It's because the designers didn't consider the man-machine interface. Essentially, they never thought about the real people down the line who would have to use the vehicle and maintain it.

An Army program called MANPRINT, for Manpower and Personnel Integration, tries to ensure the soldier is the focus when developing weapon systems. The Deputy Under Secretary of Defense for Acquisition Reform and senior officers from the other Services recently saw how helpful MANPRINT can be to them.

The Army has demonstrated that embedding human factors at the start will make a better weapon system and save billions of dollars over its life cycle. One example is the Comanche helicopter, now being test flown here by prime contractor Boeing-Sikorsky.

The RAH-66 Comanche has used MANPRINT since its inception in the late 1980s as the Army's experimental light helicopter program. Officials estimate the Service will avoid $3.29 billion in costs over the Comanche fleet's expected 20-year service life through MANPRINT.

When I first heard about this program, I thought it was just another touchy-feely program," said Todd A. Weiler, Principal Deputy Assistant Secretary of the Army for Manpower and Reserve Affairs. "Then I went down to see the aircraft and hear how this program took advantage of MANPRINT principles. I was a convert. We've had significant savings on the Comanche program. Imagine what savings we could generate if this program were DoD-wide."

MANPRINT came about following a number of Army procurement deficiencies. The first version of the Stinger anti-aircraft missile took too long to aim and fire, and short soldiers couldn't use it because the back blast would have killed them.

"By the time you went through all the steps, your target was five miles behind you," said Army Lt. Col. Mitch Howell, a MANPRINT expert with the Army Research Laboratory. "These deficiencies were corrected in later versions."

Dragon anti-tank missile users encountered similar problems. Infantrymen had to assume a weird position to fire it and then stay put to guide the dawdling missile. Meanwhile, its huge back blast of smoke and flame marked users like a bull's-eye. Anyone with an AK-47 rifle could kill the soldier before the Dragon hit home.

"The problem was the designers would build and test systems in the lab and get 90-percent success rates," Howell said. "Then they'd take the system out to the field, give it to a soldier surrounded by

RAH-66 COMANCHE. THE U.S. ARMY'S NEW AVIATION MODERNIZATION PLAN HAS AS ITS CENTERPIECE THE BOEING-SIKORSKY RAH-66 COMANCHE ARMED RECONNAISSANCE HELICOPTER. Photo courtesy The Boeing Company

smoke and dirt and people trying to kill him, and it wouldn't have close to the same success rate.

"There wasn't enough money to do it right the first time, but there was enough to modify the system after it didn't work," he said.

From these setbacks grew MANPRINT. The bottom line to many weapon system problems seemed to be the man-machine interface. Under MANPRINT, the user is an integral part of systems design.

In the Comanche program, MANPRINT means a more robust, more lethal helicopter that requires fewer people to maintain it. It also means Comanche costs less and flies more – it will require 2.6 hours of maintenance for every flight hour. The closest rival to that is the Kiowa Warrior, which needs about five hours of maintenance for every flight hour. The Army requires the Comanche to fly more than six hours a day. Current aircraft, for comparison, can fly just over two.

"Too often in the past, we looked at how much it took to build a weapon system as the 'cost' of the system," said Hal Booher, former director of the Army MANPRINT office at Aberdeen Proving Grounds, Md. "But the cost includes money needed after the system is fielded.

"How many people will it take to maintain [the system]? How much time will those people take in maintaining it? Do the areas they need to be [in] have easy access?" Booher asked. Planners also consider the tools and skills ground crews need, and their work locations and working conditions.

Comanche's MANPRINT planners specifically addressed all these questions and others. For instance, besides needing less maintenance and smaller ground crews, Comanche is designed for easy access to all service areas. Further, ground crews probably won't need appreciably higher skills than other aircraft crews, and in some cases, they might not need as much.

The important aspect of any weapon system, however, is how well people fight using it. MANPRINT officials wanted to make the aircraft easier for pilots.

"We didn't want the pilot concerned with flying the aircraft," said test pilot Nick Lappos of Boeing-Sikorsky. "We want the Comanche to be easy to fly so the pilot can concentrate on the mission. The pilot of the Comanche is a soldier first and a pilot second. We aimed to reduce the 'housekeeping' a pilot has to do and beef up the tasks directly related to combat."

The aircraft flies like a dream, Lappos said. It can dive at angles in excess of 70 degrees. Comanche can fly sideways at more than 75 knots – nearly the top forward speed of the OH-58 Kiowa it will replace.

The tail rotor is enclosed, making it safer if the chopper comes into contact with trees, for example. Comanche has a computerized feature that makes the "pop-up" maneuver safer in confined areas. Pilots doing the maneuver pop up from cover, view the area ahead, and quickly drop back. The computer helps them descend to the same spot – so if they see a target, they can pop up again already positioned to attack.

"This is a big deal," said Maj. Gen. Tom Garrett, Commander, Total Army Personnel Command, and an aviator. "Popping up out of a small clearing at night, then getting back into it is [one of the] most difficult maneuvers. That's when you put your rotors into the trees."

Similar capabilities dictated by the MANPRINT program exist in all areas of the Comanche design, from an advanced caution advisory system to onboard computer monitoring of the system's condition and maintenance history, Lappos said.

The Army program manager has incorporated MANPRINT in all development decisions. Further, an Army Training and Doctrine Command team has worked with the program manager and contractor, Boeing-Sikorsky, on MANPRINT issues. This includes assigning Army pilots and maintenance people to the project to get input from people in the field.

"You get an NCO with 16 years of turning wrenches on helicopters, and you have a wealth of expertise," said Chief Warrant Officer Pat King, a

TRADOC team member. “He’s been in the field changing black boxes on an aircraft while holding a flashlight in his mouth, and he knows whether that dog will hunt.”

Comanche is an outstanding weapon system, thanks to the emphasis on MANPRINT, said Army’s Weiler. “There is no aircraft on the horizon that will be able to touch the Comanche,” said Weiler, who flew Cobra attack helicopters during Desert Storm. “aircraft is a full generation ahead of anything on the drawing boards.”

This brand of success hasn’t gone unnoticed. The British adopted the MANPRINT program for their entire defense ministry, said Howell of the Army Research Lab. “They hold yearly symposia to ensure all their weapon systems follow MANPRINT principles,” he said. “They even used our colors and graphics, but they changed the name to ‘Human Factors Integration’ in 1993.”

The Army recently strengthened MANPRINT to help reduce the total operating costs of weapon systems. It even established a general officer steering committee, chaired by the vice chief of staff, to institutionalize MANPRINT.

“We want this to become an integral part of every acquisition,” Weiler said. “It’s too important to be dependent on personalities.”

Editor’s Note: This information is in the public domain at http://www.dtic.mil/afps/news on the Internet.

MANPRINT’s Blueprint

The Army Manpower and Personnel Integration program, MANPRINT for short, considers the human-machine interface in seven areas during the creation of a new weapon system.

The areas, called domains, are related, and all must be considered. The first six come from the first days of the program in the mid-1980s.

- Personnel Capabilities. This deals with the knowledge and physical abilities soldiers need to train on a weapon system and to operate, maintain and sustain it.
- Manpower. This involves the number of persons required or potentially available to operate, maintain and sustain, and to provide training for the system.
- Training. This deals with formal and on-the-job instruction required so users have the essential job skills, knowledge, values, and attitudes.
- Human Factors Engineering. This integrates people into system definition, design, development, and evaluation.
- System Safety. This considers design features and operating characteristics to reduce potential injuries caused by human or machine errors and failures.
- Health Hazards. This takes into account characteristics such as loud noise, chemical and biological substances, and extreme temperatures and radiation that pose risks of injury or death.
- Soldier Survivability. Added in 1994, this stems from Desert Storm, where U.S. forces experienced many friendly fire casualties. Designers now, for instance, contend with weapon ranges that exceed soldiers’ ability to discern friend from foe. Every decision in this domain involves technical aspects that affect the ultimate human decision to fire.